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Great Bay Estuary Submerged Aquatic Vegetation (SAV) Monitoring Program for 2021 Quality Assurance Project Plan

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June 2021

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Date: 2021.06.17 17:38:54 -04'00'

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Mapping Contractor:

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USEPA QA Officer:

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Nora Conlon, US EPA

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A3 – Distribution List

Table 1 presents a list of people who will receive the approved QAPP, the QAPP revisions, and any amendments.

Table 1: QAPP Distribution List

Name	Project Role	Organization	Telephone Number and E-mail Address
Kalle Matso	Project Manager	Piscataqua Region Estuaries Partnership	603-781-6591; kalle.matso@unh.edu
Trevor Mattera	PREP QA Officer	Piscataqua Region Estuaries Partnership	603-862-1310; trevor.mattera@unh.edu
Michael Routhier	Remote Sensing Contractor	UNH	603-862-1792; mike.routhier@unh.edu
Ray Grizzle	Mapping Contractor	UNH	603-767-5636; ray.grizzle@unh.edu
Erik Beck	USEPA Project Officer	US Environmental Protection Agency	617-918-1606; beck.erik@epa.gov
Nora Conlon	USEPA QA Officer	US Environmental Protection Agency	617-918-8335; conlon.nora@epa.gov

Based on EPA-NE Worksheet #3

A4 – Project/Task Organization

The project will be completed by the Piscataqua Region Estuaries Partnership (PREP). The Project Manager will be responsible for coordinating all program activities and communicating with EPA, the NH Department of Environmental Services (NHDES), and other partners. The Project Manager will supervise all contractors and field staff, be responsible for "stop/go" decisions in the field, coordinate data analysis, and be responsible for all final products. The PREP QA Officer will ensure that all QA steps are adhered to, and will be responsible for reports summarizing any deviations from the procedures in the QA Project Plan, the results of the quality control (QC) tests, and whether the reported data meet the data quality objectives of the project.

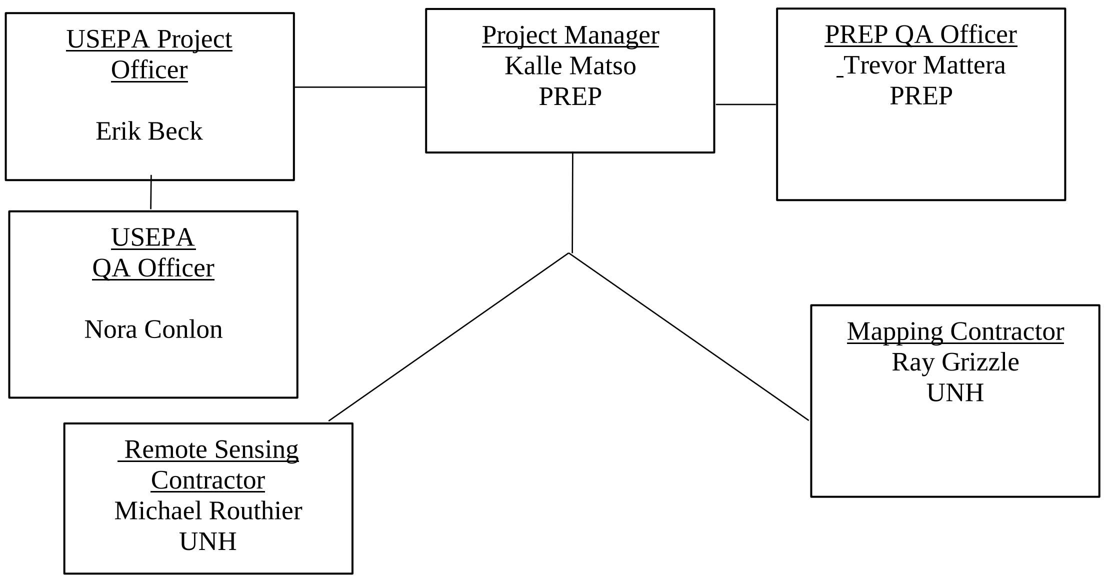
The project has three components: (1) a remotely sensed survey; (2) field verification; and (3) mapping of the remote sensing imagery/data. PREP will hire contractors to assist with all three components of the project.

The primary Remote Sensing Contractor will be Michael Routhier of the Geospatial Science Center at UNH, who will rely on unmanned aerial vehicles (hereafter, "drone") as well as satellite-derived imagery.

The field verification will be completed by PREP with assistance from Ray Grizzle. The Mapping component of the project will be conducted by Ray Grizzle under a contract with PREP. The work will consist of field surveys to calibrate the interpretation of the remotely sensed imagery to map boundaries of SAV beds.

The principal users of the data from this project will be PREP, NHDES, and EPA, as well as other interested parties. The Project Manager will submit a report to the partners at the end of the project with the final data and the QA/QC reports. Figure 1 shows an organizational chart for this project.

Figure 1. Organizational Chart.



A5 – Problem Definition/Background

Submerged aquatic vegetation (SAV), including seagrasses such as eelgrass (*Zostera marina*) and widgeon grass (*Ruppia maritima*) are essential to estuarine ecology because they filter nutrients and suspended particles from water, stabilizes sediments, provide food for wintering waterfowl, and provide habitat for juvenile fish and shellfish, as well as being the basis of an important estuarine food web. Healthy SAV both depends on and contributes to good water quality. Therefore, PREP tracks the presence of SAV in the Great Bay Estuary as an indicator of estuarine health. Note that seaweeds also provide some of these functions, but they are not usually considered SAVs as they are not vascular, rooted plants.

The objective of this project is to map SAV habitat in the Great Bay Estuary during the period from June 1 to October 1. The Great Bay Estuary is 21 square miles of tidal waters along boundary between Maine and New Hampshire. The Great Bay, the area south of Adams Point (Figure 2) has the most eelgrass and is completely located in southeastern New Hampshire.

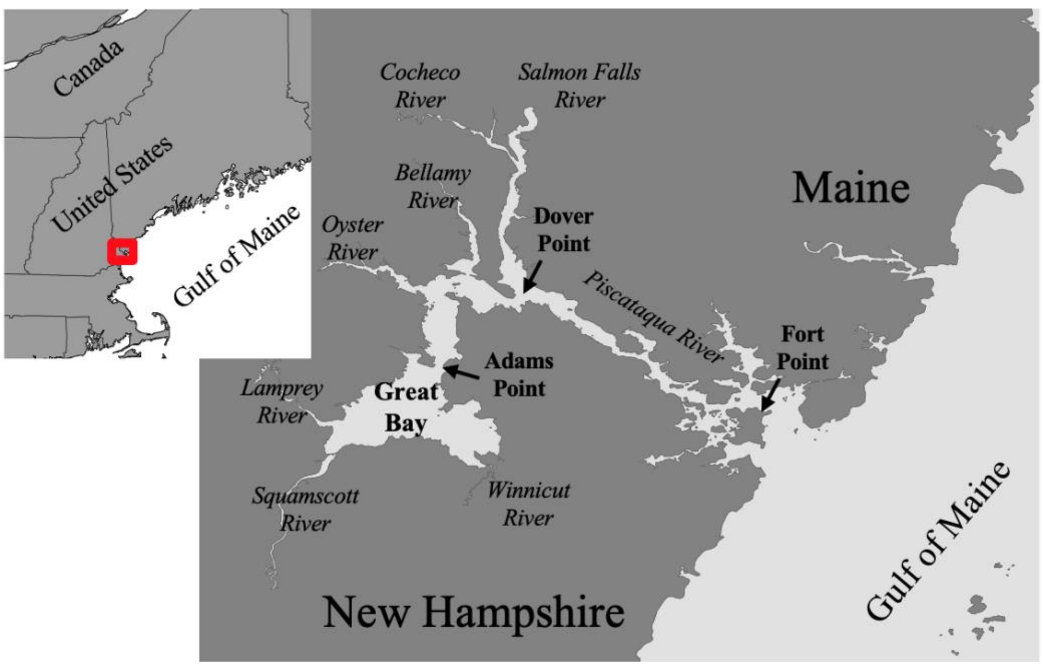


Figure 2: Study Area for 2021 mapping. In recent years, most of the eelgrass has been located in Great Bay, in the vicinity of Dover Point and in the area in Portsmouth Harbor (see Fort Point) on both the New Hampshire and Maine side.

Maps of SAV in the estuary will be used by PREP and other coastal resource managers to evaluate trends in SAV populations over time and other resource decisions.

Beginning with the 2019 effort, we are attempting to distinguish eelgrass from widgeon grass. We believe that drone imagery will be able to distinguish between the two different species of seagrass. For those areas that cannot be distinguished via remote sensing, more intense field verification will be used. Our final seagrass categories for the completed map will be eelgrass; eelgrass and widgeon grass mix; and widgeon grass.

A6 – Project/Task Description

The main tasks for the project are:

1. Hire Contractors

The Project Manager will set up contracts for the Remote Sensing Survey, Mapping, Field Verification, and Accuracy Assessment work tasks.

2. Prepare QA Project Plan

A QA Project Plan for SAV mapping will be produced by PREP. This QA Project Plan will be for 2021 only, since this is the first year that we are relying on drone image acquisition, as opposed to aerial imagery.

3. Acquire Remotely Sensed Imagery of the Estuary (and portions of contributing tributaries)

The Remote Sensing Contractor will use a combination of satellite and drone imagery. Satellite images will be used as a guide where the team should prioritize drone flights. Since satellite images can be blocked by cloud cover, we will also collaborate with LightHawk, a non-profit organization that pairs willing pilots with organizations that provide societal benefit. A member of the Tier 1 team will fly with a LightHawk pilot during the early portion of the sampling season. The LightHawk plane is outfitted with a GoPro video camera shooting downward from a housing under the plane. The recorded video will be used as a Plan B to the satellite images.

The drone imagery will be rectified with the aid of a Real Time Kinematics (RTK) ground station and will be provided to the Mapping Contractor for planning field verification and creating the final map.

4. Map Development

The Mapping Contractor will review the drone imagery and, based on field visits to the estuary (see below) and published guidance, will map SAV beds in the estuary. SAV will be categorized as present or absent; SAV coverage less than 10% cover will be deemed "absent;" more than 10% = "present." A draft report will be provided by 2/1 of the year following the flight. The final report will be prepared by 3/1 of the year following the flight.

4b. Field Verification Survey

The Mapping Contractor will visit sites where the preliminary imagery shows areas that could be interpreted in various ways. To increase the accuracy of the maps, the Contractor will visit these sites in the field to verify whether SAVs are present. See Section B1 for details.

4c. Accuracy Assessment

The Remote Sensing and Mapping Contractors will work together to select a number of random sites throughout the estuary to compare actual habitat versus mapped habitat in order to assess the accuracy of the final map.

5. Prepare Quality Assurance Reports

The PREP QA Officer will prepare a QA Report based on the final report from the Mapping contractor. The QA Report will evaluate whether or not the data quality objectives for the project have been met (see Section A7 and B5). Quality Assurance and Control for the drone work will be handled internally by the Remote Sensing Contractor. Process and accuracy statements will be documented in the accompanying FGDC-compliant metadata to ensure that the data quality meets the objectives for the project (see Sections A7 and B5).

6. Issue Final Reports, Data Management, and Archiving

After completing the quality control tests and verification/validation process (see Sections D1-D3), the Project Manager will make the final reports available to the public on the PREP website (scholars.unh.edu/prep). See Section C2 for lists of information that will be included in the final reports. GIS datasets for drone imagery and final SAV maps will be made available for download from the NH GRANIT clearinghouse. All data associated with the project will be archived with PREP as electronic files.

Table 2: Project Schedule Timeline.

Activity	Dates (MM/DD/YY)		Product	Due Date
	Anticipated Date(s) of Initiation	Anticipated Date(s) of Completion		
Hire Contractors	3/1/21	5/1/21	Executed contracts	5/30/21
QAPP Preparation or Update	2/3/21	5/15/21	Approved QAPP or approved changes to existing QAPP	5/30/21
Acquire Aerial Imagery	6/15/21	10/31/21	Raw aerial imagery	10/31/21
Delivery Prelim Images - Rectified	7/1/21	11/11/21	Orthorectified – only for Mapping Contractor use.	11/30/21
Final Data Sets for State Use	10/31/21	12/31/21	Final Deliverable: Files w/metadata	1/31/22
Mapping Work	7/1/21	12/1/21	SAV bed boundaries	3/1/22
Field Verification Survey	6/15/21	11/15/21	SAV bed boundaries	3/1/22
Draft Report	1/1/22	2/1/22	Draft report	2/1/22
QA Report	3/1/22	4/1/22	QA report	4/1/22
Final Report	1/1/22	3/1/22	Final report and files	3/1/22

Based on EPA-NE Worksheet #10.

A7 – Quality Objectives and Criteria

Data quality objectives for the aerial imagery, field verification surveys, map development, and accuracy assessment are summarized in Table 3, 4, and 5, respectively.

Table 3: Data Quality Objectives, Criteria, and Quality Control Protocols

Data Quality Objective	**Criteria**	**Protocol**
Imagery Completeness	Imagery for 100% of study area will be acquired either by satellite, low-flying aircraft, drone or acoustic survey, or any combination of the above. Drone imagery will be acquired for at least 60% of the areas that had eelgrass in 2019.	Extent of imagery will be compared to study area.
Ground Pixel Resolution	Less than or equal to 0.3 meters.	Pixel size of imagery will be compared to criteria.

	Above is for drone and acoustic data only. No data objectives for other imagery.	
Spatial Accuracy	Horizontal positional accuracy less than or equal to 0.62 meters (2 feet) Root Mean Square Error following guidance from NSSDA.* Local RTK control coordinates will be taken with a Trimble R10 receiver that has a published vertical accuracy of +/- 15mm . Drone imagery coordinates will be captured with a DJI Matrix 300 RTK that has a published vertical hover accuracy of +/- 10cm . Above is for drone and acoustic data only. No data objectives for other imagery.	The positions of 20 known locations in the rectified imagery will be checked against the known coordinates.

*Root Mean Square Error (RMSE). A measure of the difference between locations that are known and locations that have been interpolated or digitized. RMSE is derived by squaring the differences between known and unknown points, adding those together, dividing that by the number of test points, and then taking the square root of that result. Following guidance from the National Standard for Spatial Data Accuracy (NSSDA), the spatial accuracy will be calculated as the 95% confidence level using the circular map accuracy standard (Accuracy = 1.7308 * RMSE). See http://www.fgdc.gov/standards/projects/FGDC-standards-projects/accuracy/part3/chapter3 for methods.

Table 4: Data Quality Objectives, Criteria, and Quality Control Protocols for Field Verification Surveys.

Data Quality Objective	**Criteria**	**Protocol**
Spatial Accuracy	Field GPS units should have a reported accuracy less than or equal to 3 meters using NAD83 datum.	Check reported accuracy of field GPS units.
Comparability	Field observations should be collected using a standardized protocol. (NOAA 2001)	Check that protocols from the QAPP were used for field observations.
Completeness	Field observations should be made at planned locations and should ideally represent various conditions in SAV beds. At least 80% of the field verification stations should be visited.	Check field verification observation locations against planned locations. Check that 80% of field verification stations were visited.

Table 5: Data Quality Objectives, Criteria, and Quality Control Protocols for Mapping.

Data Quality Objective	**Criteria**	**Protocol**
Mapping Completeness	SAV presence-absence mapped for 100% of study area	Extent of mapped SAV will be compared to study area.
Minimum Mapping Unit (MMU)	100 square meters	The area of the smallest delineated SAV beds will be compared to the criteria. If SAV beds smaller than 100 sq meters can be

		clearlydiscerned, they will be mapped but flagged as being below the MMU.
Spatial Accuracy	Less than or equal to 5 meters	The bed edge measured at 10 field verification locations will be compared to mapped edge. See Section B2 for methods.

A8 – Documents and Records

QA Project Plan

The Project Manager will be responsible for maintaining the approved QA Project Plan and for distributing the latest version to all parties on the distribution list in section A3. A copy of the approved plan will be made available on the PREP publications web page (http://scholars.unh.edu/prep/).

Reports to Management and the Public

The Project Manager will provide the final report to the partners and will post it on the PREP publications website at: scholars.unh.edu/prep. See Section C2 for details about the final reports. All final GIS datasets will be made available for public download on the NH GRANIT GIS clearinghouse (www.granit.unh.edu).

Archiving

The QA Project Plan and final reports will be kept on file with PREP (in electronic formats) for a minimum of 10 years and/or the duration of the EPA grant.

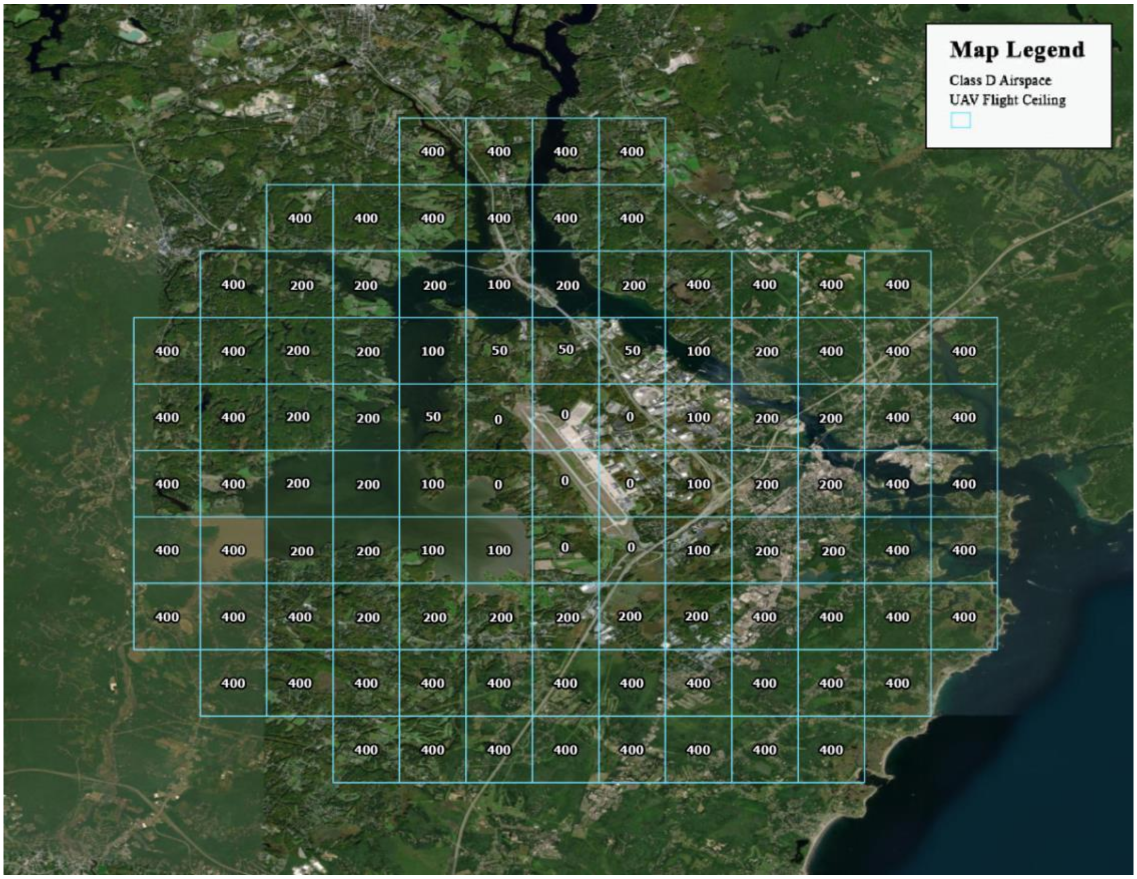


Figure 3. Pease Airport flight ceiling thresholds (in feet) issued by the FAA.

B1 – Sampling Process Design

Figure 2 indicates the sampling frame of the study: essentially, the entire area of the Great Bay Estuary. Methods with the highest breadth (and least detail)—such as satellite and/or airplane-mounted image acquisition—will be used to verify which parts of the estuary have any kind of vegetation. Then, more detail-oriented methods, such as drones, boat-based drop video, and acoustic methods, will be employed on a case-by-case basis.

We anticipate that the drones will capture imagery for approximately 70% of those areas with vegetation. The remainder will be covered by other methods. Acoustic surveys will be especially important for those areas—less than 5% of the overall area—that is not surveyable by drones because of proximity to the Pease Airport, as shown in Figure 3. Note that while 50 foot threshold still allows drone work to happen, it is not cost-effective so flying the drone in those zones is unlikely.

The final map will indicate three categories of SAV: eelgrass; mixed eelgrass and widgeon grass; and widgeon grass.

<u>Changes from Previous Surveys</u>

Percent cover assessments were used through 2015. However, for upload to the NHDES EMD database, the percent cover assessments failed the NHDES QA/QC for GIS and database acceptability in 2013 (Wood 2014). Therefore, beginning in 2016, aerial monitoring of SAV distribution has focused on presence/absence only. The presence/absence assessment is completely comparable with previous work. (EPA-approved QAPPs for 2003 and 2010 – 2014 can be found at: scholars.unh.edu/prep. Any other years between 2003 and 2016 are based on previously approved QAPPs.)

In 2017, the minimum mapping unit was adjusted (from 200 meters to 100 meters) to make it more accurate in terms of how the mapping process actually works; there is no impact on comparability.

Until 2019, all imagery has been obtained by airplane. In 2020, it was determined to switch to a drone-based approach because of the added flexibility of being able to fly on multiple days as well as the superior resolution of drone imagery.

B2 – Sampling Methods

The project has four components: (1) remote sensing survey; (2) a field verification survey; (3) the development of a map; and (4) an accuracy assessment.

Remote Sensing Survey

The Remote Sensing Survey will be coordinated by Michael Routhier, in collaboration with PREP staff. A multi-pronged approach will be used to get several layers of remotely sensed data. First, satellite-based imagery will be used to obtain a first order understanding of where vegetation is in the estuary for the purpose of prioritizing areas for drone flights. If environmental conditions exist early in the season (clear skies and clear water) for the capture of 10m spatial resolution ESA Sentinel 2 surface reflectance imagery, it will be used within a maximum likelihood classifier algorithm to create the first order understanding of where SAV exists within the estuary. It is possible that other imagery might become available for this purpose as well, such as photographs or video imagery taken from a low-flying airplane.

Once satellite-imagery has been used to assess where vegetation is located in the estuary, drone imagery will be acquired to distinguish eelgrass from widgeon grass and seaweed. The team will fly areas with highest FAA flight ceilings first to maximize aerial coverage early in the season. Past maps will also be used to prioritize those areas that have tended to be the most dynamic, changing between different vegetation types.

Collection of drone imagery will be dependent on good weather (clear and calm skies) and water (low turbidity, low - low tide) conditions. We estimate the maximum potential of 25 good and 25 fair low tide days occurring during the 2021 field season. To plan each “mission,” the Remote Sensing Contractor will use DJI’s flight planner software to set the survey flight path and associated parameters. This includes survey altitude, speed, flight path overlap, timing of photos, camera type, and focal length among other parameters, given the monitoring needs. Once the area is defined and parameters set, the resulting mission is uploaded to the drone. The survey will be conducted at maximum elevations allowed by the FAA for the Class D airspace around Pease Airport at a maximum speed of 25 mph, with an overlap of at least 70%, with cameras collecting geo-referenced photos every 0.7 seconds. (GPS data points will be collected and recorded at a rate of up to 20 Hz.) The result is a well replicated series of photos that are geo-referenced and share a high degree of similarity and commonalities (pixels) that facilitate the creation of a single, high-resolution photomosaic of the flight survey area.

Drone flights will be conducted according to the guidelines set forth by The Federal Aviation Administration (FAA) rules for the operation of small Unmanned Aircraft Systems (UAS) in the National Airspace System (NAS) in accordance with Title 14 of the Code of Federal Regulations (14 CFR) part

107. The primary drone to be used for this project will be a DJI Matrix 300. A DJI P4 RTK equipped drone will be used in conjunction with and/or as a backup drone to the Matrix 300. The Matrix will be used primarily because it has faster flight speeds, faster image capture capabilities, and longer flight times than the DJI P4 drone. The drone will be outfitted primarily with a gimballed DJI 45MP P1 Red/Green/Blue camera. Other cameras that collect either coastal blue, red edge, or near infrared imagery may also be used if they become available during the duration of this project. Imagery will be mosaiced together using Agisoft photogrammetry software. Mosaics will be shared to a project cloud folder for use by the field verification and mapping teams.

Taylor Goddard of the UNH Geospatial Science Center will be the drone pilot, holding a current FAA 14 CFR part 107 UAV (unmanned aerial vehicle) license, along with an observer who may or may not hold a UAV certification (certification not required for observer).

The imagery will be collected between June 15st and October 31st.

Field Verification Survey

The Mapping Contractor will visit a minimum of 10 sites where remotely sensed imagery shows SAV habitat and a minimum of 10 sites where the "signature" is confusing. (See "Completeness" in Table 4). Based on pilot work conducted in 2020, we anticipate that much of the drone imagery will not require field verification, unless it is to distinguish between eelgrass and widgeon grass. In contrast, satellite images will require more field verification. The choice of the number and location of field verification sites will be dictated by the need to capture the diversity of signatures (particular appearances) that indicate the presence of seagrass versus mud or seaweed habitat. More than 10 sites for each category may be needed, depending on the variety of signatures evident in the imagery. A minimum of five additional sites will be selected where SAV was previously mapped but is no longer visible in the satellite imagery. The rationale is to ensure that actual SAV habitat was not mistakenly missed due to issues such as turbidity. Again, the number of sites depends on the number of areas where things have changed from previous years. Additional sites will be selected as needed to capture the diversity of signatures.

Field observations will be made using a drop camera and high accuracy GPS during the same time period as the image acquisition: that is, between June 15 and October 31. The locations (stations and transects) to be visited will be determined by the Contractor by reviewing previous SAV maps and from satellite and drone imagery. As an alternative and in areas where SAV is known to persist, SAV maps from previous years will be used to select stations and transects. It is anticipated that eight days of field work will be necessary.

The following protocol will be used for field verification observations.

1. Record station number and time. Record water depth from boat depth finder if available.
2. Record observations at station and/or along transect on the standardized field sheet
    - Classify the SAV cover as either absent or present, using Appendix A as a guide.
    - Record observations of features that may provide confusing signatures in the aerial photography (e.g., seaweeds). (While seaweeds are often noted in field notes, they will not be "mapped;" only SAVs will be mapped.)
3. Save photographs and video collected at the station and record filenames on field datasheet (see Appendix B.
4. Record any other observations from the site on the field sheet.

The following protocol will be used for edge mapping for "spatial accuracy" (see Table 5).

1. Use underwater video camera and visual inspection (where water depths and clarity permit) to locate the boundary of the SAV bed. In areas where the SAV boundary is gradual, the point at which SAV is visually estimated to have less than 10% cover will be defined as the boundary. (Note that the edge of a bed is defined as an area when the continuous bed no longer meets the 10% cover threshold for "presence," and a bed is "continuous" when the patches are no more than 1 m apart.)
2. Mark the boundary using GPS every 5-10 meters along a 50-meter boundary. Record coordinates from GPS in DD.DDDDDD format.
3. Coordinates will be routinely recorded in a GPS file and available after the field visit. Coordinates will be handwritten only if not recorded in a GPS file.
4. After the map is produced, coordinates from the above exercise will be compared with the mapped edge in order to fulfill the data quality objectives noted in Table 5.

<u>Map Development</u>

The Mapping Contractor will perform field work to guide the mapping. Field observations will be made by the Mapping Contractor along transects using a drop camera and high accuracy GPS within 30 days of the last drone surveys, which will be on or before September 30, 2021. Transects will be recorded in a GPS as routes and observations will be taken using a drop camera along the route. Multiple observations of presence/absence of eelgrass, widgeon grass, presence of seaweeds, and other features will be made. These observations will be geo-referenced and used in a GIS to clarify and correct interpretations of SAV distribution.

The methods that will be used for the actual Map Development are described in Section B4.

B3 – Sample Handling and Custody

Not applicable. No samples will be collected.

B4 – Analytical Methods

Digital photographs will be mapped using methods from Short and Burdick (1996), NOAA (1995), and NOAA (2001) to delineate the boundaries of SAV beds. The boundaries of SAV beds will be interpreted from orthophotos and polygons will be created using a GIS. Observations made during site visits by the Mapping Contractor (see Section B2) will be used to assist in the location of polygon boundaries. The visual guides that will be used for determining the 10% cover class cut-off from the aerial imagery are provided in Appendix A. These guides have been widely used as aids for interpretation and mapping, including in Chesapeake Bay.

Topology rules will be created in a GIS to identify and correct gaps and overlaps between polygons. The projection for the SAV bed shapefile will be New Hampshire State Plane-Feet with a horizontal datum of NAD83 (CORS96).

B5 – Quality Control

Drone Surveys

Quality Assurance and Control will be handled internally by the Remote Sensing Contractor. Process and accuracy statements will be documented in the accompanying FGDC-compliant metadata to ensure that the data quality meets the objectives for the project (see Sections A7 & B5).

Pre-flight planning will be completed with DJI drone deploy software.

Project flights will take place during good sky and water conditions that include:

- Early morning flights before wind speeds pick up (Usually before 10:00am)
- Low sun angle (Ideally 30 degrees)
- Clear sky conditions (No rain, little haze, no fog)
- Calm winds (<10 mph)
- No preceding rain events
- Low turbidity

Red/Green/Blue (RGB) imagery will be captured using a DJI 45MP P1 Camera at FAA Class D Airspace maximum altitudes around Pease Airport. Imagery will be captured with at least a 70% overlap to maximize the potential for mosaicking of imagery. Coastal blue, red edge, and near-infrared bands may also be collected if cameras become available during the field season.

In-flight rectification will be completed using a DJI Mobile II RTK ground station kit tied to 6 to 8 high resolution RTK GPS sited tie points located around the study area. All imagery will be collected within 2km of one of these ground station tie points to maximize spatial accuracy as recommended by DJI specifications. GPS/IMU data will be tagged to each image collected.

All flights will be completed by an FAA Part 107 certified drone pilot. The pilot will be in charge of all safety and flight operation procedures. Remote spotters in communication with the drone pilot via walkie-talkie will be utilized to keep the drone in visual distance.

Mosaicking of imagery will be completed using Agisoft Photogrammetry software. UAV mosaicking over water often results in missing data where the software fails to mosaic. Mosaics will be checked for missing locations upon their creation and those locations will be scheduled for re-flights when applicable.

Image mosaics will be shared among team members via a cloud drive throughout the season and will be delivered as geo-referenced TIF and/or JPG files.

Field Verification Survey

The Project Manager will check that the data quality objectives were met using the criteria and methods from Table 4 in Section A7.

Map Development

The Project Manager will check that the data quality objectives were met using the criteria and methods from Table 5 in Section A7.

B6 – Instrument/Equipment Testing, Inspection, Maintenance

All equipment used for Remote Sensing Surveys shall be inspected prior to the flight to ensure proper operation. Drop cameras and GPS units for the Field Verification Survey shall be inspected, charged, and cleaned before each field day.

B7 – Instrument/Equipment Calibration and Frequency

Drone equipment flight checks, camera checks, UAV registration to RTK sited ground control markers via a DJI Mobile II ground station, and compass calibration will be completed before each flight. RTK site locations will be sight staked and logged for future use. The DJI Matrix 300 UAV will fly within the flight guidelines provided by the manufacturer.

B8 – Inspection/Acceptance Requirements for Supplies and Consumables

Not applicable.

B9 – Non-direct Measurements

Information on tides and weather will be used to decide on the dates for the drone surveys. The data sources that will provide this information are:

- Tides: NOAA Tide Predictions at Fort Point, Dover Point, and the Squamscott River span the study area.
    - Fort Point (Portsmouth Harbor) https://tidesandcurrents.noaa.gov/noaatidepredictions/NOAATidesFacade.jsp?Stationid=8423898
    - Dover Point https://tidesandcurrents.noaa.gov/noaatidepredictions/NOAATidesFacade.jsp?Stationid=8421897
    - Squamscott River https://tidesandcurrents.noaa.gov/noaatidepredictions/NOAATidesFacade.jsp?Stationid=8422687
- Weather: Weather predictions for Portsmouth, NH are available from http://forecast.weather.gov/MapClick.php?CityName=Portsmouth&state=NH&site=GYX&textField1=43.0568&textField2=-70.782&e=1

B10 – Data Management

Orthophotographs from the Remote Sensing Surveys will be stored on hard drives by the Remote Sensing Contractor. The final imagery files will be transferred to the Project Manager via a cloud drive. Either raw or mosaicked images will be delivered directly to the Mapping Contractor by the Remote Sensing Contractor via a cloud drive. The Project Manager will provide the link to the cloud drive to the Mapping Contractor and to the NH GRANIT clearinghouse. The orthophotographs will be uploaded to the NH GRANIT GIS clearinghouse for public distribution. The following file formats will be used for the imagery:

- Raw imagery as true-color composite JPG files, geolocated using RTK based geo-referencing.
- Final imagery as orthorectified 3-band (red, green, blue), 8-bit imagery mosaics in uncompressed GeoTiff or Geo-JPG format.

- The imagery mosaics will be projected in New Hampshire State Plane-Feet NAD83 and shall have metadata meeting FGDC standards.

SAV bed boundaries from the Mapping Contractor will be delivered on thumb or hard drives to the Project Manager in shapefile format compatible with ArcGIS in New Hampshire State Plane-Feet NAD83 projection. The shapefiles will be stored in a dedicated project directory on the PREP computers. The shapefiles will also be uploaded to the NH GRANIT GIS clearinghouse for public distribution. Field verification information collected by the Mapping Contractor—including video and still imagery as well as field sheets—will be included.

C1 – Assessments and Response Actions

The Project Manager will be in frequent communication with contractors during the project. The Project Manager will ask about difficulties encountered and ensure that protocols from the QA Project Plan are being following. At a minimum, the Project Manager will complete the following checks while the project is proceeding.

- Review QC Plan for Remote Sensing contract
- Review Field Sampling Plan for Mapping contract
- Review QC Plan for Mapping contract
- Conference with Remote Sensing Contractor after each month of the image acquisition period (June through October).
- Conference with Mapping Contractor after first day of field work
- Review of imagery provided by Remote Sensing Contractor
- Review draft report from Mapping Contractor
- Review and approve any other reports provided by contractors

The Project Manager will initiate appropriate response actions after each check, if needed.

C2 – Reports to Management

The final report for this project will focus on the Mapping of Aerial Imagery for SAV Habitat Mapping and will contain the following:

- Abstract
- Introduction
- Methods
  - Methods for drone surveys
    - Any other surveys (e.g., acoustic), if applicable
  - Methods for field verification surveys
  - Methods for mapping of SAV beds
  - Methods for quality control checks
- Results

    - Summary of the area of seagrass cover (in acres) in the Great Bay Estuary, divided into three categories: eelgrass; mixed eelgrass and widgeon grass; widgeon grass
    - Maps showing the location of SAV beds in the Great Bay Estuary at a scale of 1:24,000.
- References
- Appendices/Attachments
    - Raw field survey data
    - Quality-assured SAV bed boundaries as an ArcGIS shapefile (compatible with ArcGIS10) in New Hampshire State Plane-Feet NAD83 projection with project metadata meeting FGDC standards.

D1 – Data Review, Verification, and Validation

The final reports from the Remote Sensing Contractor and the Mapping Contractor will be provided to the Project Manager. The Project Manager will review the reports and final reports will be provided to the EPA Project Officer for review prior to providing copies to the public.

The Project Manager will be responsible for independently assessing that the data quality objectives from Section A7 have been met for each report using the criteria and methods from Sections A7 and B5. The Project QA Officer will prepare a QA Report that documents the results of quality control tests. The QA Report for the Mapping contract will include all Field Verification Survey data used to assess the data quality objectives.

D2 – Verification and Validation Procedures

The Project Manager will review the QA Report from the Project QA Officer to see if there have been deviations from the QA Project Plan and if the data quality objectives have been met. Any decisions made regarding the usability of the data will be left to the Project Manager; however, the Project Manager may consult with project personnel and partners, if necessary.

D3 – Reconciliation with User Requirements

The Project Manager will be responsible for reconciling the results from the final report with the requirements of the study (the ultimate use of the data). Results that are qualified by the Project Manager may still be used if the limitations of the data are clearly reported to decision-makers. The decision-making process will be:

1. The Project Manager will review data with respect to sampling design.
2. If the data quality objectives from Section A7 are met, then the user requirements have been met and the SAV maps can be used without qualification.
3. If the data quality objectives from Section A7 have not been met, the Project Manager will consult with project personnel and partners and make a recommendation about whether the SAV maps are still usable for their intended purpose or whether the data need to be qualified or rejected. The Project Manager may also initiate appropriate corrective actions to improve the quality of the data, if possible. Corrective actions may include providing comments on the draft report from the contractor and asking for revisions.

4. The Project Manager will document this decision-making process in a memorandum that will be appended to the QA Report.
5. The QA Report will be attached to the final report from the contractor to document any QA concerns and qualify the data, if needed.

References

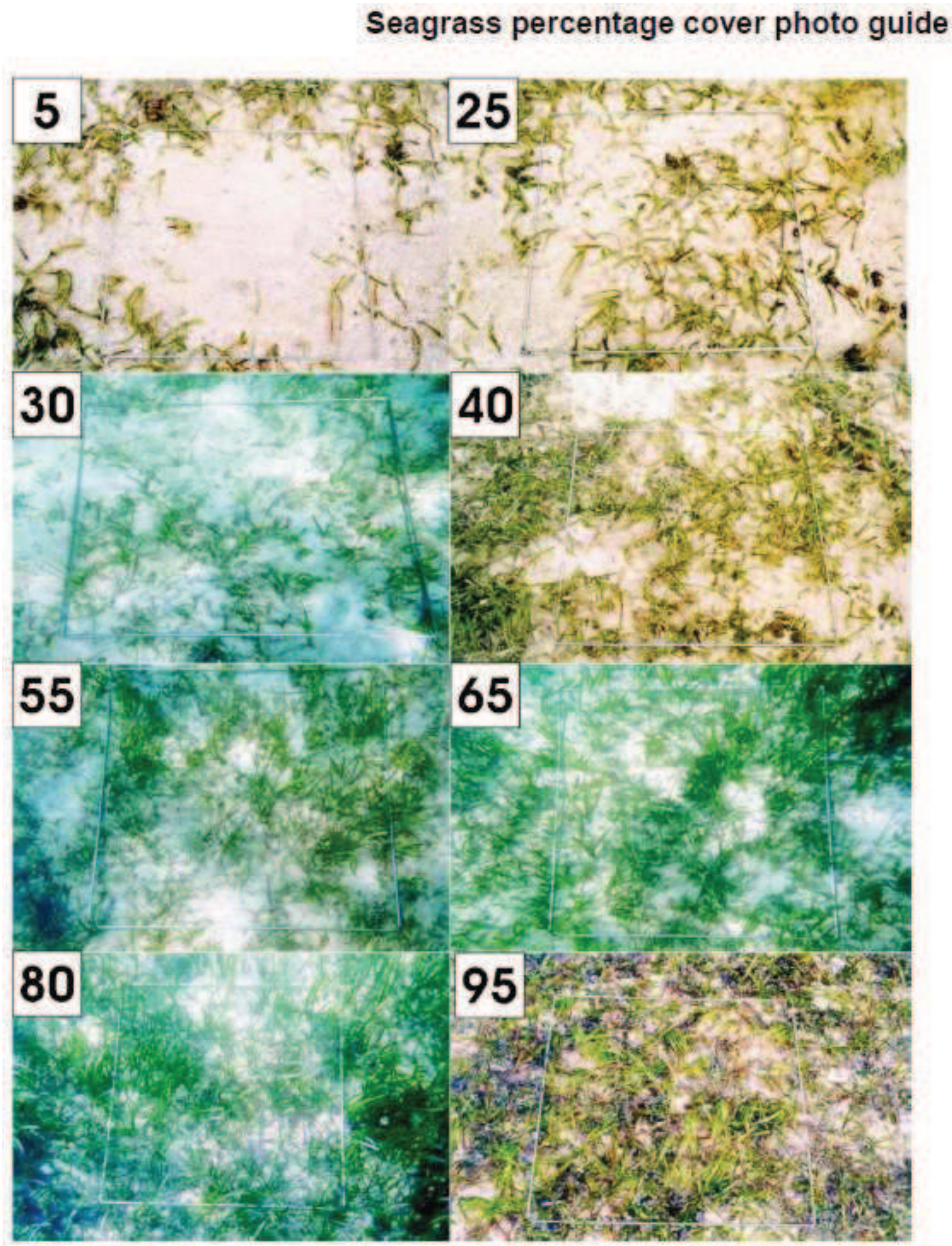
National Oceanic and Atmospheric Administration (NOAA). 1995. NOAA Coastal Change Analysis Program (C-CAP): Guidance for regional implementation by J.E. Dobson, E.A. Bright, R.L. Ferguson, D.W. Field, L.L. Wood, K.D. Haddad, H. Iredale, J.R. Jensen, V.V. Klemas, R.J. Orth, and J.P. Thomas. NOAA Technical Report NMFS 123. http://www.csc.noaa.gov/crs/lca/pdf/protocol.pdf

National Oceanic and Atmospheric Administration (NOAA). 2001. Guidance for Benthic Habitat Mapping: An Aerial Photographic Approach by Mark Finkbeiner [and by] Bill Stevenson and Renee Seaman, Technology Planning and Management Corporation, Charleston, SC. NOAA/CSC/20117-PUB. http://www.csc.noaa.gov/digitalcoast/_/pdf/bhmguide.pdf

Short FT and Burdick DM (1996) Quantifying eelgrass habitat loss in relation to housing development and nitrogen loading in Waquoit Bay, Massachusetts. *Estuaries*, 19:730-739.

Wood, MA (2014) Memorandum: Quality Assurance of 2013 Great Bay Estuary Eelgrass Monitoring Program". Quality Assurance Project Plans. 3. http://scholars.unh.edu/qapp/3

Appendix A Visual Guides for Seagrass Percent Cover in Quadrats

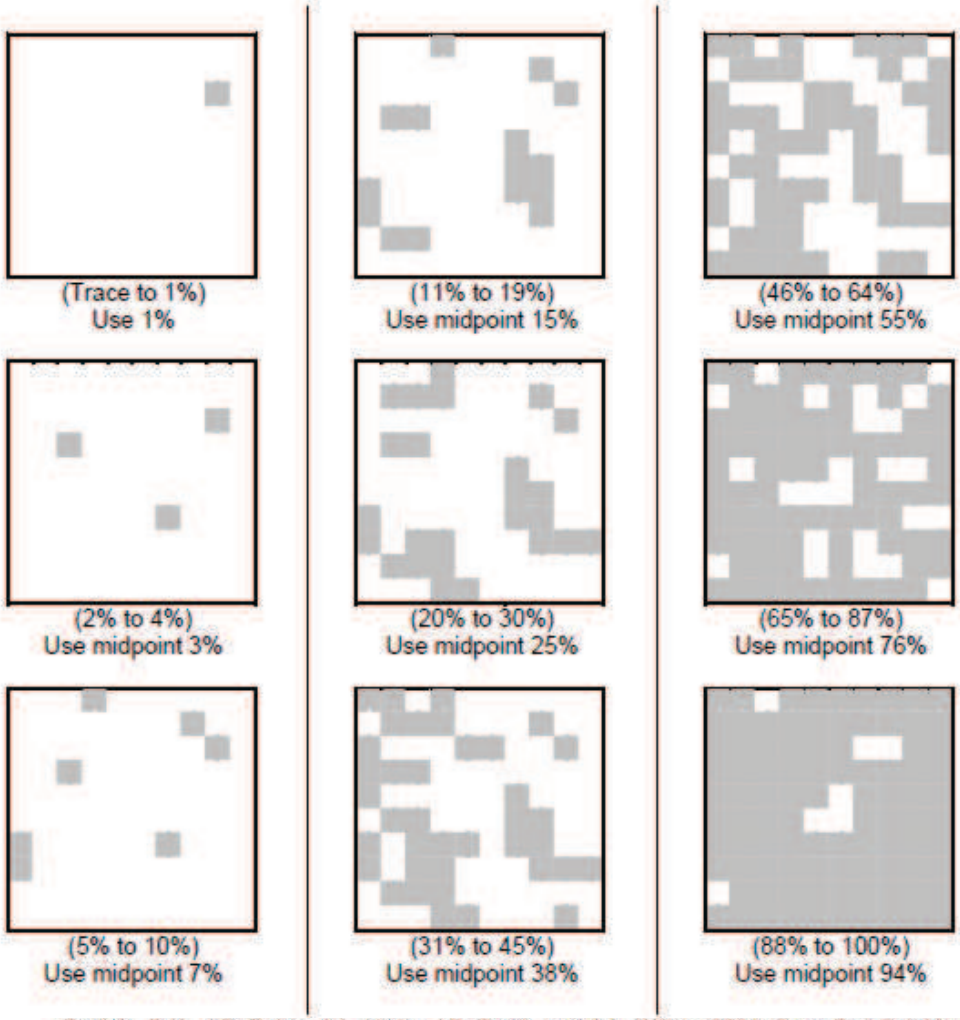


Source: SeagrassNet Short, F.T., McKenzie, L.J., Coles, R.G., Vidler, K.P., Gaeckle, J.L. 2006. SeagrassNet Manual for Scientific Monitoring of Seagrass Habitat, Worldwide edition. University of New Hampshire Publication. 75 pp.

Plant Survey

Standard Cover Classes and Midpoints for Estimating Abundance

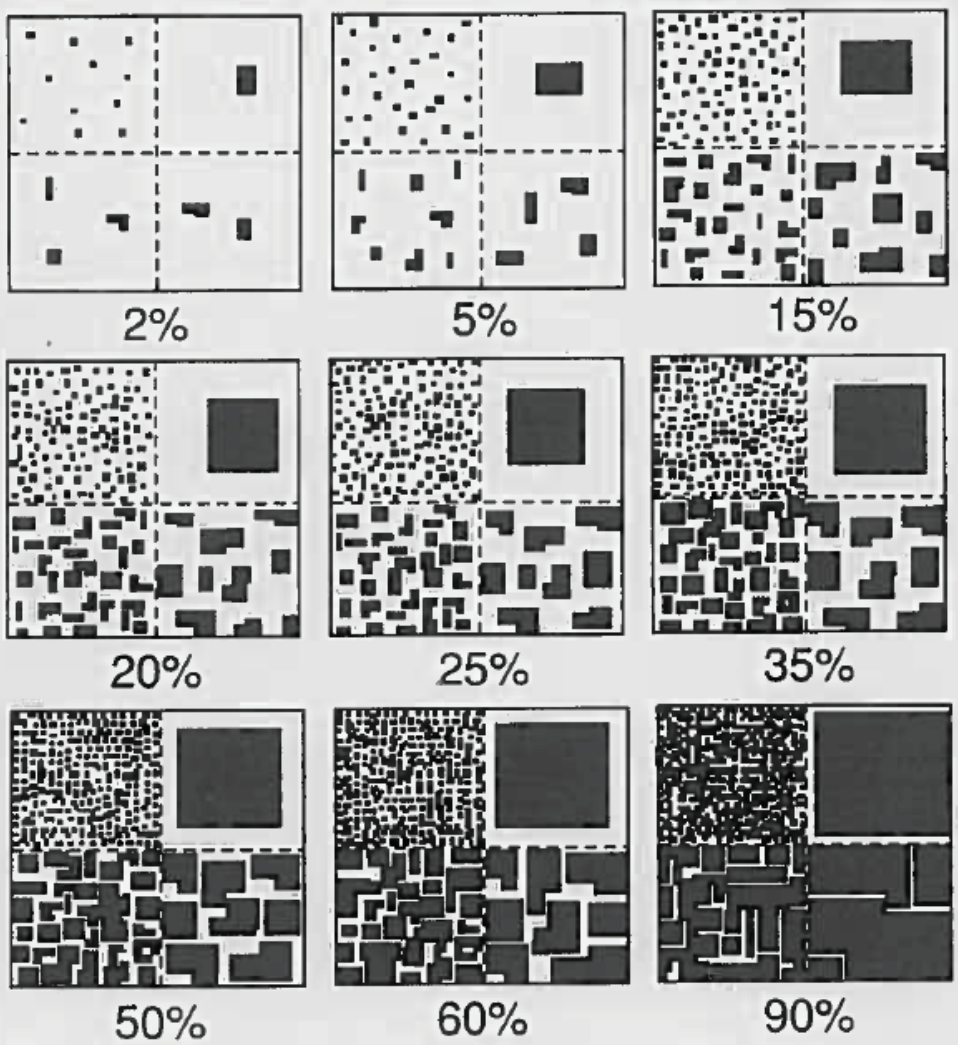
One method for obtaining abundance values for vegetation surveys is to estimate the percent of a plot occupied by the target plant. To assess percent cover, one estimates the area of the plot frame ($1m^2$) that is covered by all of the leaves, branches, and stems of the target species. Visual estimates may vary from one person to another. This variability can be significantly reduced by using standard cover classes and midpoint abundance values. The following figures illustrate 9 standard cover classes to use. For each plot, first identify and list the species present, then for each species determine which figure best describes its cover. Record the midpoint value on the data sheet.



Carlisle, B.K., J.D. Baker, A.L. Hicks, J.P. Smith, and A.L. Wilbur. 2004. Cape Cod Salt Marsh Assessment Project; Final Grant Report, Volume 1: Relationship of salt marsh Indices of Biotic Integrity to surrounding land use, 1999 Boston, MA. Massachusetts Office of Coastal Zone Management.

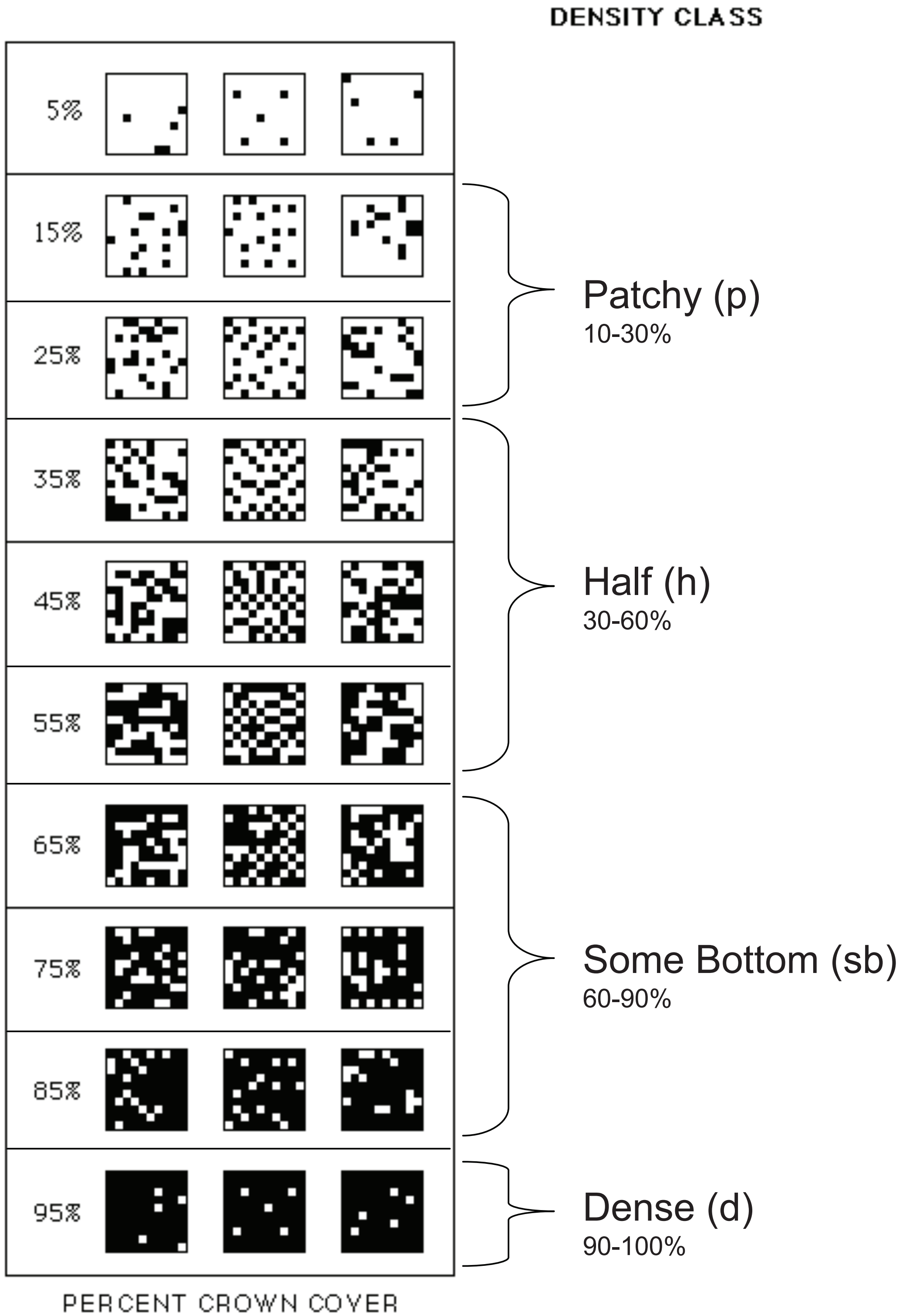
EXAMPLES OF PERCENT OF AREA COVERED

The following graphic can be used for various data elements to convey "Amount" or "Quantity." ***NOTE***: Within any given box, each quadrant contains the same total area covered, just different sized objects.



Source: USDA/NRCS. Field Book for Describing and Sampling Soils. September 2002.

Visual Guide for Eelgrass Percent Cover for Photointerpretation



Source: http://web.vims.edu/bio/sav/sav11/crown_density.html

Appendix B

Field Data Sheet - SAV Ground Truth Monitoring

Station Number		Date MMDDYY							
Crew Chief		Crew Member 1							
Crew Member 2		Crew Member 3							
Purpose for Visit									

Weather Condition	☐ Sunny ☐ Partly Cloudy ☐ Overcast ☐ Rainy ☐ Windy ☐ Foggy
Sea Condition	☐ Calm ☐ Choppy ☐ Rough
Time On Station	: (HH : MM EDT)
Water Depth	. (meters, one decimal place)

Latitude		.						DD . DDDDDD format
Longitude		.						DD . DDDDDD format

Drop Camera Observations

SAV Cover	☐ Less than 10% More than 10% ☐ Not Present
Algal Cover	☐ Less than 10% ☐ More than 10% ☐ Not Present
Filenames for Photos or Video	
Notes	

Field Data Sheet - SAV Ground Truth Monitoring

Station Number		Date MMDDYY						

Edge Mapping

Marker	Latitude (DD . DDDDDD)								Longitude (DD . DDDDDD)							
1		.								.						
2		.								.						
3		.								.						
4		.								.						
5		.								.						
6		.								.						
7		.								.						
8		.								.						
9		.								.						
10		.								.						
Notes																